PROFILE

# AFV WEAPONS

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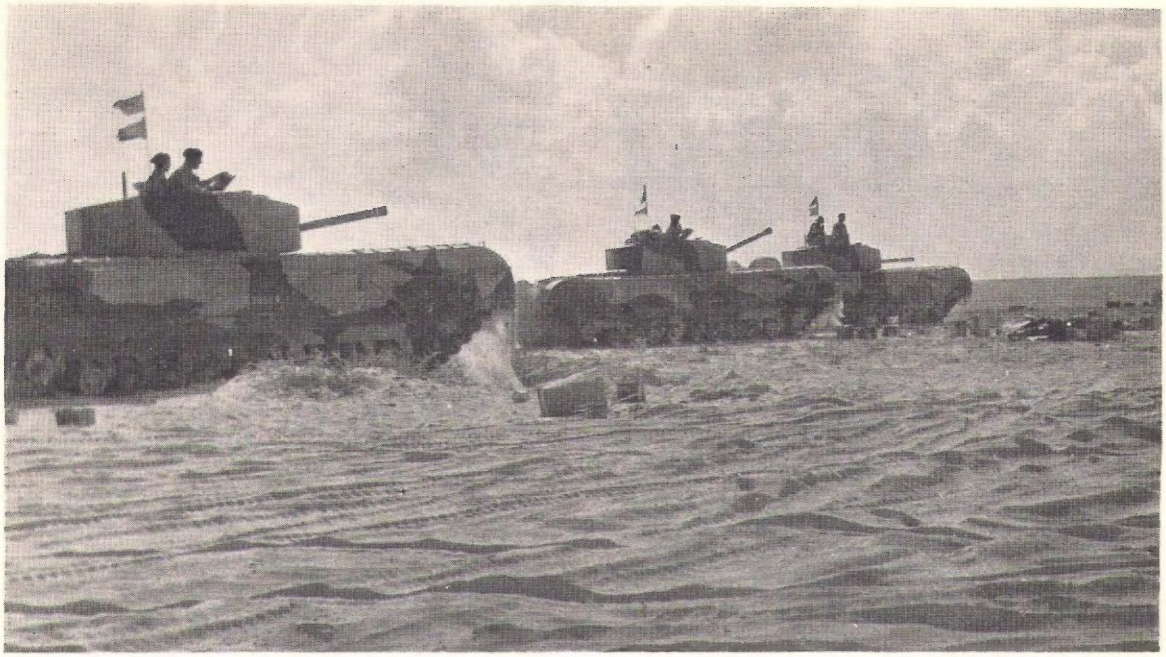
# CHURCHILL, B.I.T. Mk IV





*The trio of Churchill IIIs sent to the African desert for testing under combat conditions with the 7th (Motor) Brigade at the time of Alamein. They were used for propaganda shots, as depicted here, and played no significant part in the Alamein battle.* (Imp. War Mus.)

# Churchill—British Infantry Tank Mk IV

By B. T. White

"THE Sqn. Ldr. was ordered, at all costs, to force a way past Steam Roller Farm and annihilate the enemy at the head of the Pass. Two tanks, commanded respectively by Capt. E. D. Hollands, D.C.M., and Lieut. J. G. Renton, succeeded in breaking through. Together they covered the 1,500 yards which separates Steam Roller Farm from the head of the Pass. To do this they had to advance down a narrow causeway from which no deployment was possible. This causeway was covered by an 88 mm. gun firing at a range of less than 200 yards. It fired two shots, which missed the leading tank, which charged, and the gun crew fled. The two tanks slowly wound their way to the top of the Pass, which was very steep and rocky. There, they had the shoot of their lives, but the remainder of the Sqn. and the Coldstreams were unable to force a passage and join them and they were finally ordered to withdraw. Before they did they accounted for two 88 mm., two 75 mm., and two 50 mm. anti-tank guns, four lesser anti-tank guns, 25 wheeled vehicles, two 3-inch mortars, two Mk. III Tanks and about 100 Germans.

"A wireless message from the commander of the German Bde. Group to General von Koch was intercepted. This was to the effect that he had been attacked by 'a mad tank battalion' which had scaled impossible heights and forced him to withdraw."

Some of the excellent qualities of the Churchill tank are brought out in this account of the first action in which the 51st Battalion Royal Tank Regiment took part—in Tunisia on February 28, 1943—when part of "A" Squadron was engaged in support of infantry of 2nd Battalion Coldstream Guards. It is further recorded in the *Short History of 51st Bn. Royal Tank Regiment*, from which the extract is taken, that for their part in this minor but vivid action, the two tank commanders were awarded respectively, a D.S.O. and an M.C., and members of their crews gained one D.C.M. and two M.M.'s.

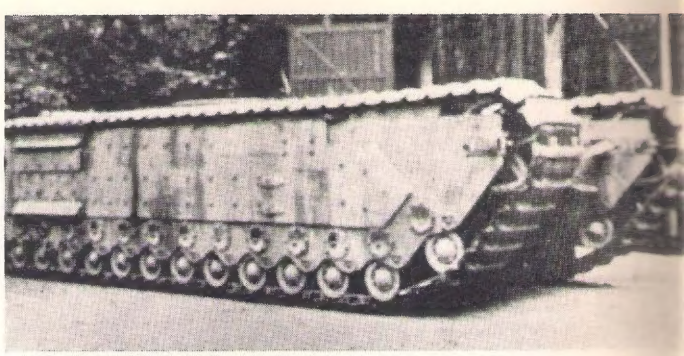
The Churchill had had a somewhat unfortunate history up until this time: it was designed to a specification still influenced by memories of World War I and produced in haste under the invasion threat of 1940–41, which resulted at first in a great deal of mechanical unreliability. Sent into action for the first time in the Dieppe raid of August 1942 in an opposed landing, the majority of the tanks were not even able to get ashore, let alone have a chance of proving their value in battle.

By early 1943, however, a great deal of development work by the designers, reinforced by the practical experience of the regiments equipped with the Churchill tank, had eliminated most of the early faults so that one regiment (the 142nd Regiment R.A.C.) was able to say (referring to their tanks just after landing in North Africa)—

> "The Churchill tank won its spurs for mechanical efficiency during this march southwards. Twenty-four tanks [all those involved in this particular operation] arrived at Sbiba without any mechanical breakdown. Some of these had come straight off their transporters without time for minor adjustments; while the few 'B' squadron tanks that had set out for the Bou Arada front moved on their tracks without a hitch a hundred miles in 24 hours."

The main armament of the Churchill had, by 1943,

been considerably improved by the substitution of the 6 pdr. gun for the 2 pdr. fitted in the early models. The 6 pdr. was a good gun capable of knocking out the German Tiger tank in favourable circumstances—as was demonstrated in Tunisia. The Churchill, designed to provide support in close co-operation with infantry across shell torn ground, was also shown in Tunisia to be capable of tackling difficult hill country—terrain probably not envisaged by the General Staff planners mindful of the Flanders battles of 1914–18.



*Rare view of A20/E1 pilot model built by Harland & Wolff to meet the original requirement for a "shelled area" infantry tank, and subsequently sent to Vauxhall to become the basis for the Vauxhall-designed A22. Similar configurations to that used in the Churchill I is evident.* (Peter Chamberlain Collection)

## CONCEPTION AND BIRTH

The history of the Churchill goes back to the General Staff specification A.20, for an infantry tank to supplement and replace the A.12 or Tank, Infantry Mark II—better known as Matilda. (The Infantry Mark III—Valentine—was designed by Vickers Armstrong without the benefit of a G. S. specification but was nevertheless accepted by the War Office for mass production.)

The French Maginot and German Siegfried lines of fortifications facing each other seemed in 1939 likely to bring about the same sort of stalemate on the Western Front as in World War I. Tank design to overcome this problem in support of the French ally followed two lines of thought. One was left to an independent committee under the chairmanship of Sir Albert Stern and composed, like himself, of men who had had close associations with tanks in World War I. The alternative solution was sought through the more conventional means of a General Staff specification. The A.20 specification, put forward in September 1939, called for an infantry tank able to negotiate waterlogged ground cratered by shell fire; to overcome moderate vertical obstacles and gaps; and with frontal protection on a 60 mm. basis to give protection against 37 mm. anti-tank guns. A speed of only 10 m.p.h. was required. Various forms of armament were considered, the original proposal being a 2 pdr. gun with coaxial Besa machine-gun in a sponson at each side and a Besa and a 2-inch bomb thrower beside the driver—armament very much on the lines of the World War I tanks. Other weapons given consideration were the 3-inch howitzer and the 3·7-inch howitzer (both rejected because of their low muzzle velocities); the Army 6 pdr.; the Naval 6 pdr.; the French short 75 mm.; and a combination of a turret-mounted 2 pdr. with a hull 6 pdr. between the front horns. The final choice was, however, an infantry Tank Mark II pattern turret mounting a 2 pdr. gun and coaxial 7·92 mm. Besa machine-gun; a 2 pdr. in the front of the hull and a 7·92 mm. Besa at either side of the hull.

The specification as finally decided was put into broad practical terms of design by the Chief Superintendent of Design at the Woolwich Royal Ordnance Factory, and the engineering and shipbuilding firm of Harland and Wolff Ltd. of Belfast were awarded a contract in December 1939 to design and supply four mild steel pilot models of the A.20, designated Tank, Infantry Mark IV. They were to be powered either by a 300 b.h.p. diesel engine being developed by Harland and Wolff or by a new Meadows flat 12-cylinder petrol engine. The final drive was to be of the type developed

*His Majesty the late King George VI inspects the first production model of the Churchill I, then still known only as the Infantry Tank Mk. IV, in March, 1941. Ordered straight off the drawing board, this was also the "pilot" model, and was made of mild steel.* (Peter Chamberlain Collection)

for the A.13 Mark III (later known as Covenanter) through a gearbox designed by Dr. H. E. Merritt. The four vehicles were known individually as A20E1, A20E2, A20E3 and A20E4.

Harland and Wolff Ltd. had the first A.20 pilot completed, except for the turret and armament by the middle of 1940 and ready for running trials. Its general appearance, despite the decision not to include side sponsons, was broadly suggestive of the heavy tanks of World War I: the long hull, necessary for good cross-country performance, had overall tracks with the top run level with the hull roof and a high prow for facility in mounting obstacles. The long pitch tracks and the suspension consisting of small independently sprung road wheels are said to have been inspired by the Char B1 *bis*, one of the best contemporary French heavy tanks.

The trials of the A.20 proved to be disappointing, for the gearbox gave trouble after only a short run, the Meadows DAV engine did not produce the required power and calculations showed that the front hull 2 pdr. would have to be sacrificed to maintain the planned performance and keep within reasonable distance of the specified weight of 37½ tons, already increased from the originally estimated 32 tons. Vauxhall Motors were asked to design a new engine for the A.20 and the result—a Bedford 12-cylinder side valve unit—produced the required 350 b.h.p. right from the start. Nevertheless it was decided to abandon the A.20 in June 1940, with two of the four pilot vehicles still unbuilt.

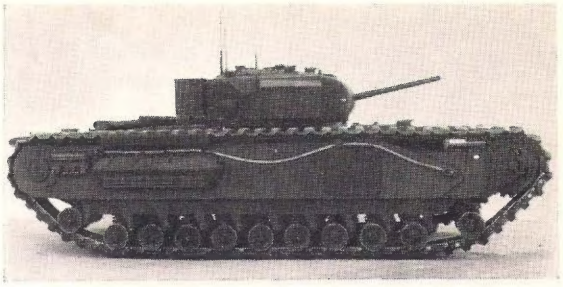
A revised specification for Tank, Infantry Mark IV —A.22, was then drawn up and Vauxhall Motors Ltd. of Luton, Bedfordshire, were invited to undertake the detail design, followed by production "off the drawing board" of the new vehicle. This was July 1940, when France had capitulated to the German armies and invasion of the United Kingdom was expected to follow at any moment.

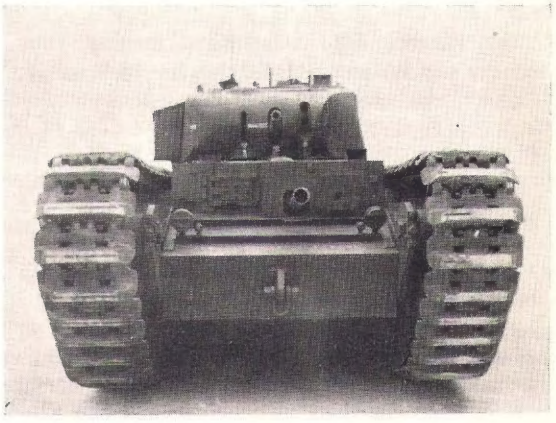
The task was accepted by Vauxhall Motors. Dr. H. E. Merritt, Director of Tank Design, with a small staff of draughtsmen (who had already prepared some preliminary drawings for the A.22) moved to Luton. The drawings of the A.20 were used for guidance in layout and one of the two A.20 pilot vehicles (neither of which had the turrets or armament fitted) was sent to the Vauxhall factory, where it was test run to provide data on the Bedford engine designed for it by Vauxhalls and which was also to be used for the new tank.

The A.22 was, in a sense, designed around the Bedford 12-cylinder engine, although since this engine had originally been intended for the A.20 it was possible to use much of the configuration of the earlier tank.

A larger gun than the 2 pdr. was envisaged for the A.22, but since in 1940 the 2 pdr. was the only high velocity tank weapon available in production it had to be used. The 2 pdr., however, did not fire the high explosive ammunition so useful for infantry support and so provision was made for a 3-inch howitzer in the front of the hull beside the driver.

The first prototype A.22 was undergoing trials by the end of 1940 and the first batch of 14 completed Tanks, Infantry Mark IV came off the Vauxhall Motors production line in June 1941. It may be noted that the first of these vehicles still bore the "Caution Unarmoured" plate which denoted to the users that

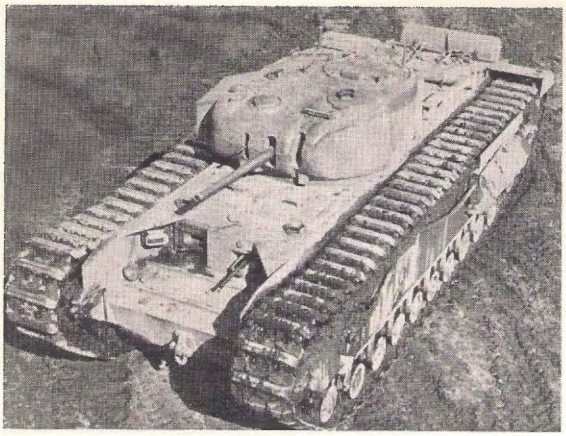




*Three views of one of the first production Infantry Tank, Mk. IV taken at Luton May 9, 1941, show the characteristics of the Churchill I, including the 3-in. howitzer in the hull front, small cast turret with pistol ports and 2 pdr. gun, brackets for long range fuel tank at rear, lack of track covers, unarmoured exhaust manifolds and the original type of intake louvre.* (Imp. War Mus.)

mild steel had been used wholly or partially instead of armour plate. The new tank was named Churchill—because, as Mr. Winston Churchill is reputed to have said, it too was "a thick-skinned beast".

The remarkably short time in which the Churchill was designed and put into production by Vauxhall Motors Ltd.—a firm without previous experience of the design or construction of tanks—reflects great credit on it. At the same time as designing the tank and arranging to build the first vehicles, Vauxhall Motors also undertook the design and production "parentage" for the whole future programme planned for the Churchill. This entailed arranging sources of supply of materials from hundreds of sub-contractors for the ten other major firms in the production group as well as for Vauxhall's own output; planning the production operations; designing and obtaining the special equipment—jigs, machine tools etc.—needed for production; and passing on their newly acquired "know-how".



*In the Churchill II, the 3-in. howitzer was replaced by a Besa machine-gun. The front horns were also fitted with strengthening plates, added retrospectively also to the Mk. I. Note the fuel tank at rear.* (Peter Chamberlain Collection)

*Fine view of the Churchill II in service in early 1942 shows all crew members at their respective hatches.* (Peter Chamberlain Collection)

The Churchill Tank Production Group consisted of the following firms (not all of which, however, remained on Churchill production throughout the War):—

The Birmingham Railway Carriage and Wagon Co. Ltd.
Beyer, Peacock and Co. Ltd. (Manchester)
Broom and Wade Ltd. (High Wycombe, Bucks.)
Dennis Bros. Ltd. (Guildford, Surrey)
The Gloucester Railway Carriage and Wagon Co. Ltd.
Harland and Wolff Ltd. (Belfast, Northern Ireland)
Leyland Motors Ltd. (Leyland, Lancs.)
Metropolitan-Cammell Carriage and Wagon Co. Ltd. (Wednesbury, Staffs.)
Newton Chambers and Co. Ltd. (Sheffield)
Charles Roberts and Co. Ltd. (Wakefield, Yorks.)

There were many problems in co-ordinating the work of such a variety of engineering firms spread throughout England and one in Northern Ireland. But the arrangements worked well considering the difficulties. For example, the first Leyland-assembled Churchill was completed in June 1941 (concurrently with the first production models produced by Vauxhall Motors themselves) and the first Metro-Cammell Churchill was delivered early in July 1941. The production of Churchill tanks continued until the War ended and in all 5,640 were built. In numerical importance the Churchill came second only to the Valentine.

A supply of completed tanks coming off the production lines was required by the Government within one year from the time Vauxhall Motors undertook the responsibility for the design and output of the Churchill tank in July 1940. It was expected that an entirely new tank built under these conditions would be likely to give trouble later on, but tanks that could run only a dozen or so miles, or even, acting as immobile but heavily armoured blockhouses, not run at all, might make all the difference were the country to be invaded, and the risk was accepted. (Much was made in wartime propaganda of the virtue of the Churchill's potential value as a static blockhouse. Fortunately, this need never arose for the defence of the United

*Mr. Winston Churchill, the Prime Minister, paid a visit to Vauxhall in 1941 to see the tank which later took his name. He is seen here in the second production vehicle (nearest the camera) talking by R/T to General Sir John Dill, C-in-C Home Forces, in the first production machine. Note the triangular warning plate on the turrets indicating mild steel construction.* (Imp. War Mus.)

Kingdom, but in Tunisia on one occasion a single Churchill, disabled on a minefield, continued to support the infantry against an enemy counter-attack by infantry with two tanks. For this action the tank commander was awarded the M.C.)

During trials and in the hands of the Army tank battalions to which the Churchills were issued as they came off the production lines many faults were revealed. A survey by the War Office showed in November 1941 that Churchills delivered up to the previous month were not fit for use in the Middle East or even for sustained operations in the United Kingdom unless 16 important modifications were incorporated. Ten of these modifications were to the transmission and steering and three to the suspension. Nearly 1,000 tanks had to be re-worked out of the first 1,200 built, and as late as July 1942 both reworked and new Churchills were failing their acceptance tests at mileages as low as 150. Some failures, at least, in Churchill tanks were probably caused by misunderstanding, in experienced units, of the degree of maintenance required. In one Army tank battalion (converted from an infantry unit) for example, only 30 tanks out of 54 were fit to go out on one exercise. Of these, a third did not return to camp afterwards. (It was recorded, however, that most of them seemed to have broken down near roadside cafes, leaving the suspicion that old soldiers were not above exaggerating, when convenient, the incapacity of their tanks!)

The clutch was one major source of trouble in the early days—the clutch cover showed a tendency to burst when only a slight excess over engine maximum permitted revolutions occurred. Apart from this and other less serious design faults which were corrected as quickly as possible in existing vehicles and eliminated, where practicable, in the production stage, trials and user experience indicated the need for modifications of various sorts. In order to ensure the maximum co-operation between the manufacturers and the customers Vauxhall Motors appointed their own engineers to each of the Army tank brigades equipped with

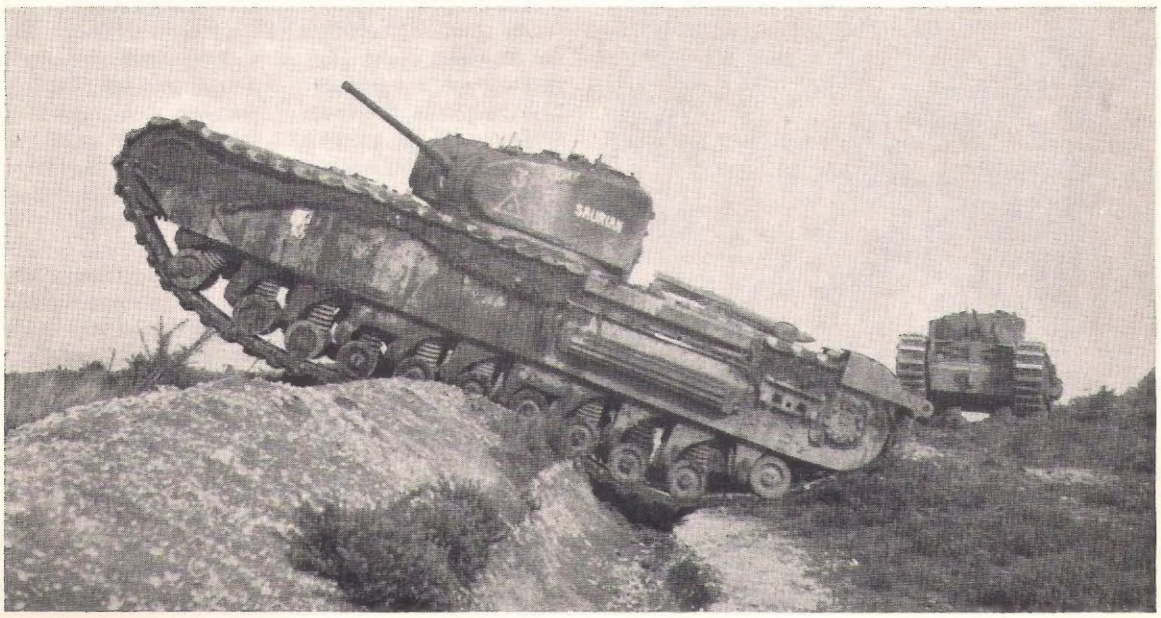
*Close-up view of a Churchill II turret, with the vehicle commander studying his map.* (Imp. War Mus.)

Churchill tanks. These men no doubt learned a few home-truths about the product for which they were responsible, but they were able both to give useful advice to the tank units and at the same time to help ensure close and immediate liaison with the manufacturers, so that early action could be taken to rectify faults and design modified components where necessary. This was one of the means whereby, after a long series of modifications had been introduced, the Churchill was eventually considered to be a very reliable and battleworthy tank.

## THE CHURCHILL DESCRIBED

The Churchill was developed through eight different Marks and numerous sub-variants but the layout and main features, except for the armament and the armour thickness, remained fairly constant throughout,

*Churchill IIs seen on a Southern Command exercise in October 1942.* (Imp. War Mus.)



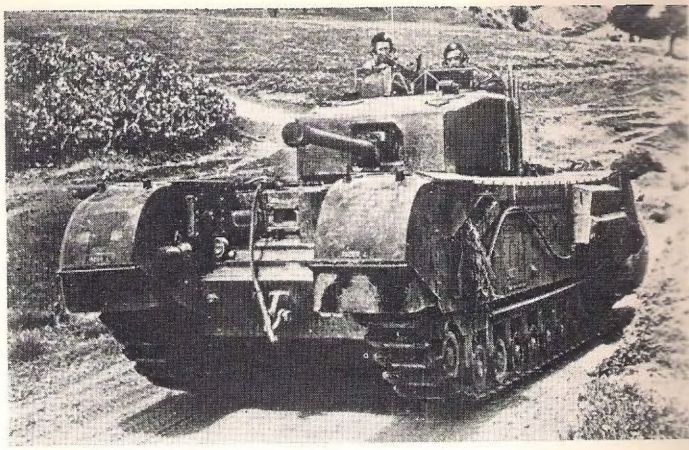
although various improvements were introduced during the course of production and in re-working earlier Marks. In describing the Churchill, therefore, the details of the armament and armour will be left to be outlined in a summary of the Mark by Mark differences.

The hull of the Churchill was basically a box structure constructed of flat steel plates joined together by steel angles, to which they were riveted. To this inner shell of the hull structure the armour plates were bolted, the bolts being screwed into the armour plates from inside. Escape doors were provided in either side of the hull giving access to the tank via the driver's compartment. These doors (except in the later tanks, Marks VII and VIII) were fitted with quick opening revolver ports. In the roof of the hull, double-hinged doors were provided for the driver and front gunner; and in the hull floor six removable plates gave access to various components. The compact design of the suspension gave an almost uninterrupted "pannier" space at each side of the hull between the upper run of the track (which was level with the hull roof) and the lower run. This useful space was used for the stowage of equipment and ammunition and also carried the main right-hand and left-hand fuel tanks.

The interior of the hull was divided transversely into four compartments. The front compartment contained the driver's position and the driving controls for the tank and, on the driver's left, the hull gunner's seat, the hull armament being mounted in the same vertical plate as the driver's vision port.

The steering control was a centrally pivoted handle bar (rather like that of a bicycle) mounted just below the driver's vision door. This operated the steering brakes through a Lockheed hydraulic system and was equipped with air pressure servo-motors to make operation easy. The gear change lever was at the driver's right, and on the floor, from left to right, were

*A Churchill II rears over a "knife-edge" to show its hull top to the camera. Note the early small-type cast turret was not symmetrical. Commander's hatch (left) rotated. The cylindrical container on the turret side is a stowage for the signal flags.*
(Peter Chamberlain Collection)



*A typical III with the added features which became standard on all Churchills from mid-1942 onwards: full track covers, and the improved engine air intake louvres which had the opening on the top instead of the sides, so facilitating waterproofing for deep wading.* (Peter Chamberlain Collection)

the clutch pedal (connected to an air pressure servo-motor to make for light operation); the foot brake pedal (operating the main brakes through a Lockheed hydraulic system); and the accelerator pedal. The hand brake lever was mounted on the floor at the left of the driver. Except in the Churchill VII and VIII, a half handle bar steering control in the front gunner's position was linked to the main handle bar to enable the hull gunner to steer the tank in an emergency, and a duplicate ignition switch would allow him to switch off the tank's main engine.

The next division was the fighting compartment, with the turret mounted on a ball race on the hull roof. From the turret, and forming an integral part of it, was suspended the platform carrying the commander, gunner and wireless operator. The turret could be traversed when the engine was running by an electric motor carried in it and geared to a fixed toothed ring mounted in the hull roof. An alternative hand traverse system was available for use with the engine stopped. The power traverse was operated by means of a control handle which speeded up the turret rotation the farther left or right of centre the handle was moved. The ball race on which the turret rotated was 58¼ inches in diameter and consisted of 117 steel balls in a bronze cage. The platform which rotated with the turret and formed the floor for the three men in the fighting compartment was suspended from the turret at three points and was constructed of "Plymax"—a multiply wood faced each side with sheet metal.

The tank's wireless equipment was carried inside the turret on a shelf at the back. This consisted of a wireless transmission set providing both long range communications and also communications over short distances operated separately on a higher frequency. The aerial for the long range equipment was at the rear of the turret at the left-hand side and the shorter, short range aerial was at the right-hand side. A separate intercommunications system enabled the crew members to speak to each other.

Behind the fighting compartment, separated by a bulkhead, was the division containing the engine. On the outside of the hull each side at this point were the

*A Churchill II leaves a LCT in May, 1942, during trials and exercises for the Dieppe landing. Note intake louvres have been removed to avoid fouling the sides of the LCT, and that this tank has the then new, full track covers.* (Imp. War Mus.)

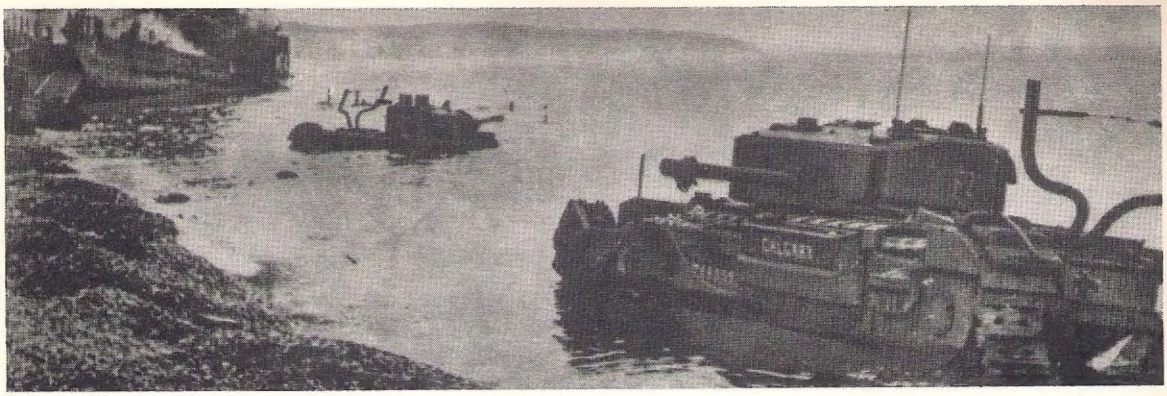
projecting heavy armoured louvres protecting the engine air intakes. These louvres were removable for rail transport. Finally, behind the engine in the rear of the tank was the compartment housing the gearbox; the steering brakes and the main brakes; the air compressor (a two-cylinder Clayton Dewandre unit) for the assisted steering and clutch operation; the auxiliary charging set for the electrical system and the generator for the turret power traverse.

The Bedford horizontally opposed 12-cylinder engine drove the tracks through driving sprockets at the rear. The Borg and Beck clutch was of the single dry plate variety: operation was assisted by compressed air power through a hydraulic system. At one stage of the Churchill's development, incidentally, until new clutch facings were designed by Ferodo Ltd., it was thought that a twin-plate clutch would have to be substituted for the single plate type.

The gearbox was fitted transversely and parallel to the final drive to the driving sprockets. The Merritt-Brown gearbox was designed by Dr. H. E. Merritt and developed and built by David Brown Tractors Ltd. It combined the gears for regulating the engine power transmission with a steering unit working on the controlled differential principle. This adjusted the power during a turn between the inside and outside tracks (the inner track in a turn moving more slowly) and offered a greater degree of control than other contemporary steering systems in that a variety of turning radii were available, depending on the gear chosen. The lowest gear gave the sharpest turn and with the gear in neutral the tank swung on its pivot point. Five-speed gearboxes were fitted in the earliest production Churchills but these were soon replaced by a redesigned 4-speed model which gave approximately the same speed range over its four forward ratios. It is interesting to recall that a self-changing gearbox, designed by the Fluidrive Engineering Co. Ltd., was tested in Churchill tanks (also, it is believed, another make of automatic gearbox) but the mechanical type was retained in all but the experimental vehicles.

The suspension of the Churchill was of a pattern not hitherto used in British tanks and comprised 11 small 10-inch diameter steel bogies (or road wheels) each side, mounted on short trailing arms and independently sprung on vertical coil springs. The idler wheels were at the front and the driving sprockets at the rear. The tracks used on the Churchill were of three types—a heavy cast steel type (the original design), a light cast steel type with improved shoe pattern and a final type

*The Churchill III had a new, larger, welded turret and mounted the 6 pdr. gun. This is an early production vehicle still fitted with the original pattern engine air louvres. In the driver's position is Major D. Thorpe, 4th C.L.Y., at that time Chief Instructor, 56th Training Regiment, R.A.C. Catterick. The A.F.V. Series Editor, Duncan Crow, is at the front of the turret gunner's hatch.* (Peter Chamberlain Collection)



*The Churchill's first and unhappiest action; Dieppe on the afternoon of August 19, 1942. Canadian Churchill III tanks, of the Calgary Regiment knocked out on the beaches. Note the exhaust pipe extensions for deep wading. See colour drawings for finer detail.* (Imp. War Mus.)

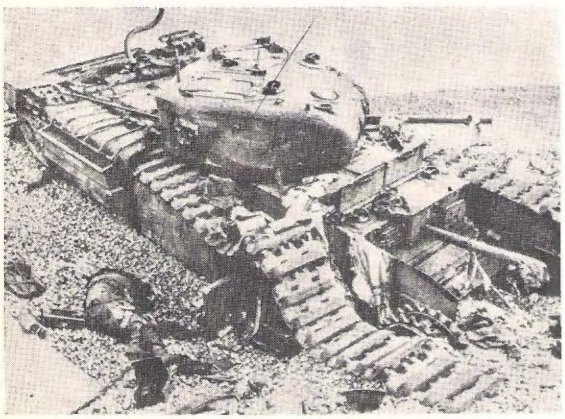
of similar profile to the light cast steel type but made of manganese steel. The Churchill VII and VIII were fitted only with the manganese tracks, although all three types could be used on all Marks.

## THE BASIC MARKS

The first model of Churchill to be produced—known at first only as Tank, Infantry Mark IV—had a 3-inch howitzer in the front hull, and a 2 pdr. gun with coaxial Besa machine-gun in the cast turret. The next model, Tank, Infantry Mark IVA, which was in production very shortly afterwards, was identical except for the Besa replacing the 3-inch howitzer in the hull and associated changes in ammunition stowage. Although already known unofficially as Churchill, this name was adopted for general use instead of the type mark numbers and suffixes following a minute (including, rather coyly, in its text "A.22 has an alias, I think") sent by the Prime Minister in June 1941 to the Secretary of State for War and the Chief of the Imperial General Staff. The first two models of Tank, Infantry Mark IV then became known as Churchill I and Churchill II respectively.

The next model, Churchill III, was the first Churchill to be fitted with the 6 pdr. gun. Discussion on this question began in March 1941 and three different types of the 6 pdr. turret—welded, cast and bolted—

*A Churchill I knocked out on the beach at Dieppe, August 19, 1942.* (Imp. War Mus.)



were designed and tested, following which, in August 1941, Babcock and Wilcox Ltd. were given a contract for the production of welded turrets.

As well as being used in current production Churchill III's, earlier tanks were subsequently reworked and had their 2 pdr. turrets replaced with the new type equipped with the 6 pdr.

The Churchill III, together with some Churchill I's, was the type used by the Canadians at Dieppe on August 19, 1942, and these were the first Churchill tanks to be used in action against the enemy. The Prime Minister had been anxious to see the new tanks in action at the earliest opportunity and caused two Churchill tanks to be sent in September 1941 to the Middle East where they could be tested under desert conditions and any necessary modifications made to fit this type of tank for employment in the Libyan battles. They arrived in December 1941 but, through inadequate protection against the weather on the voyage, were in very bad condition. Later on, three Churchill III's were received by the 1st Armoured Division and allotted to 7th (Motor) Brigade for desert trials. During the battle of Alamein (October 1942) they were used as H.Q. vehicles by the Brigade commander and, later, in action, when one was knocked out by an 88 mm. gun and the guns jammed in the other two tanks.

A number of Churchill III's and earlier Marks were supplied in the latter half of 1942 under Lend Lease to the Russians who, though no doubt glad enough to receive them at that time, regarded them, like all British tanks, as under-armed.

The Tunisian campaign of First Army saw the first use in action of the Churchill IV, together with a greater quantity of Churchill III's and, for close support, a number of Churchill I's. The Churchill IV was identical to the Churchill III except for the turret, which was cast instead of welded. Two tank brigades (six regiments) of Churchill tanks were in Tunisia by the end of the campaign in May 1943. Their remarkable cross-country performance—the only form of transport other than mules to get up some hills in the "Longstop" area for example—and their good 6 pdr. gun earned the confidence of their crews. One fault, however, of the 6 pdr. was that although its armour-piercing performance was good (an infantry 6 pdr. knocked out the first Tiger tank encountered by the

*A Churchill III of another Canadian tank unit, the 12th Canadian Tank Regiment (The Three Rivers Regiment) taking part in Exercise Spartan in Southern England, March 1943.*
(Peter Chamberlain Collection)

British army), it was not designed for high explosive ammunition for use against other targets. To make up for this deficiency as quickly as possible for the forthcoming Italian campaign the complete gun mountings (with 75 mm. gun and coaxial 0·30 inch Browning machine-gun) including the external mantlets, were removed from Sherman tanks and installed in Churchills in place of the turret 6 pdr. and Besa. (The hull Besa machine-gun was also replaced, experimentally, by a Browning, but it was proved rather difficult to cover the hole left in the mounting, and the Besa was put back!) The American 75 mm. gun was a good all-round weapon, capable of firing all types of ammunition, although its anti-tank properties were inferior to the 6 pdr. 120 Churchill IV's (and one solitary Churchill III, which did not get far as it was accidentally driven into the sea over the edge of a quay) were converted in this way by the 21st Tank Brigade workshops in North Africa and became known as Churchill "N.A.75's".

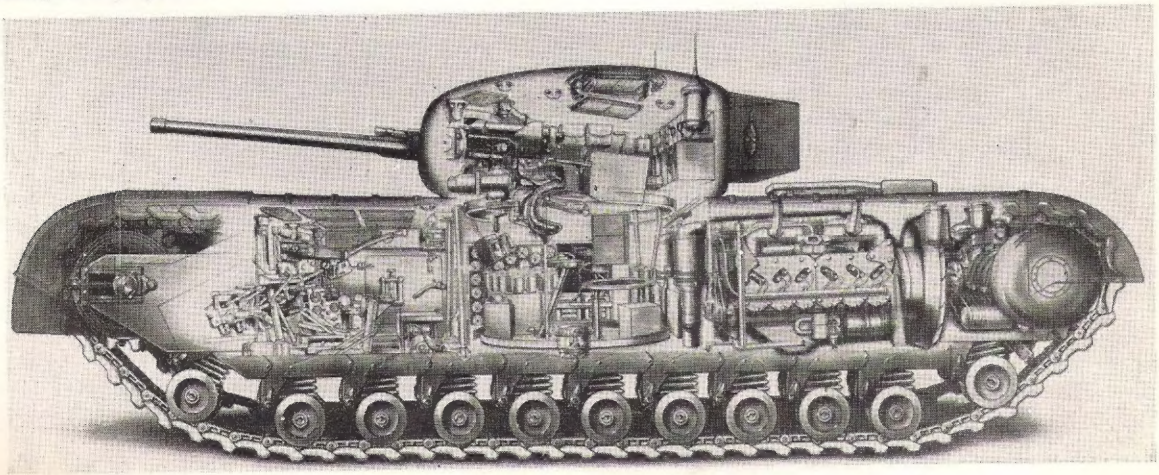
In the meantime, back in Britain a programme of reworking earlier 2 pdr. models with new 6 pdr. turrets to bring them up to Churchill III standard had been undertaken from the end of 1942 onwards. These and other earlier improvements were in many cases introduced in stages so that some of the Churchills with the new armament still had, for instance, the old pattern of side air intake louvres. The policy of re-working Churchills to bring them up to approximately the same standards in armament and protection (as well as in the incorporation of improved mechanical components, where possible) as current production vehicles was continued throughout the War and in all 3,092 tanks were rebuilt.

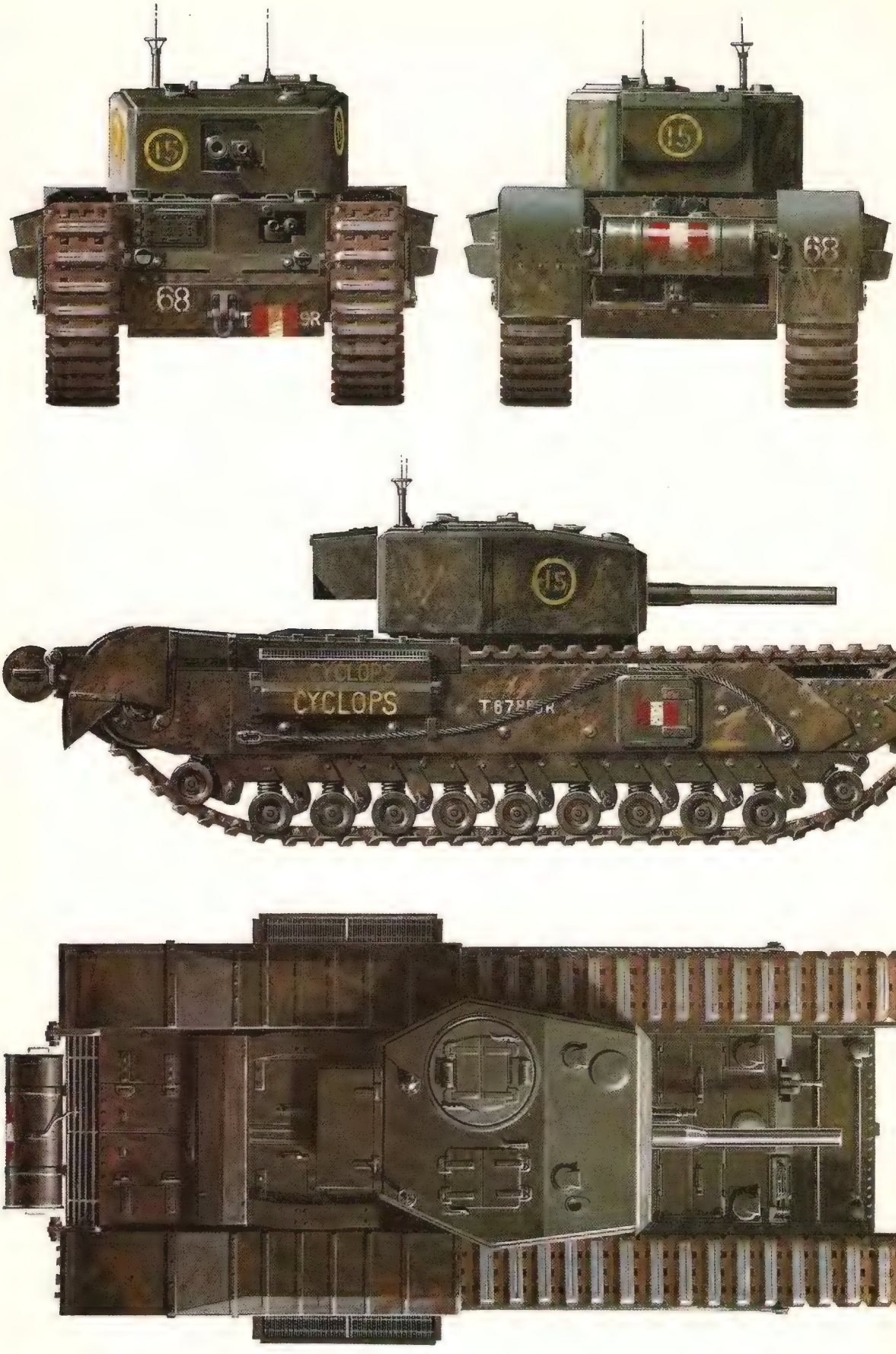
A heavier close support weapon for tank use was designed to replace the 3-inch howitzer and this, the 95 mm. howitzer, was incorporated in the Churchill V, which apart from the main armament and associated ammunition stowage was almost identical to the Churchill IV. The Churchill V, together with the later Mark VIII, was used in the North-West Europe campaign but in Italy Churchill I's continued to be employed for close support work, although a modification was introduced in that the turret 2 pdr. was replaced by a 3-inch howitzer, so that the tank then carried two howitzers. An experimental development in the United Kingdom, known as Churchill IICS (i.e. close support), had a 3-inch howitzer in the turret and a 2 pdr. in the hull position, but this version was not used in action.

The first introduction into the Churchill of the British-built 75 mm. dual purpose gun (which was developed from a bored-out 6 pdr.) was in the Churchill VI—apart from some earlier experimental vehicles. This gun was fitted with geared elevation, unlike the 2 pdr. and the 6 pdr., and marked the final breakaway from the old Royal Tank Corps tradition of quick firing by tanks on the move. Churchill VI was identical to the Churchill IV except for this armament change. The 75 mm. gun had inferior penetrative ability to the 6 pdr., but fired a 13¾ lb. projectile. This had a muzzle velocity of 2,030 feet per second. For comparison with a weapon the Churchill frequently encountered, the Panther's KwK 42 (L/70) of the same calibre fired a 15 lb. shell at a muzzle velocity of 3,068 feet per second with getting on for twice the British gun's penetration at 500 yards.

The advance in the power of enemy tank and anti-tank weapons caused the armour protection of the Churchill to be increased. Supplementary armour—known as appliqué—was added to the hull sides (including the side doors) and to the hull nose plate. In addition, tank units in action, particularly during

*"Ghosted" view of the Churchill IV clearly shows the interior layout and location of all the roof hatches used by the crew. Note ammunition stowage in the far pannier.*
(Peter Chamberlain Collection)

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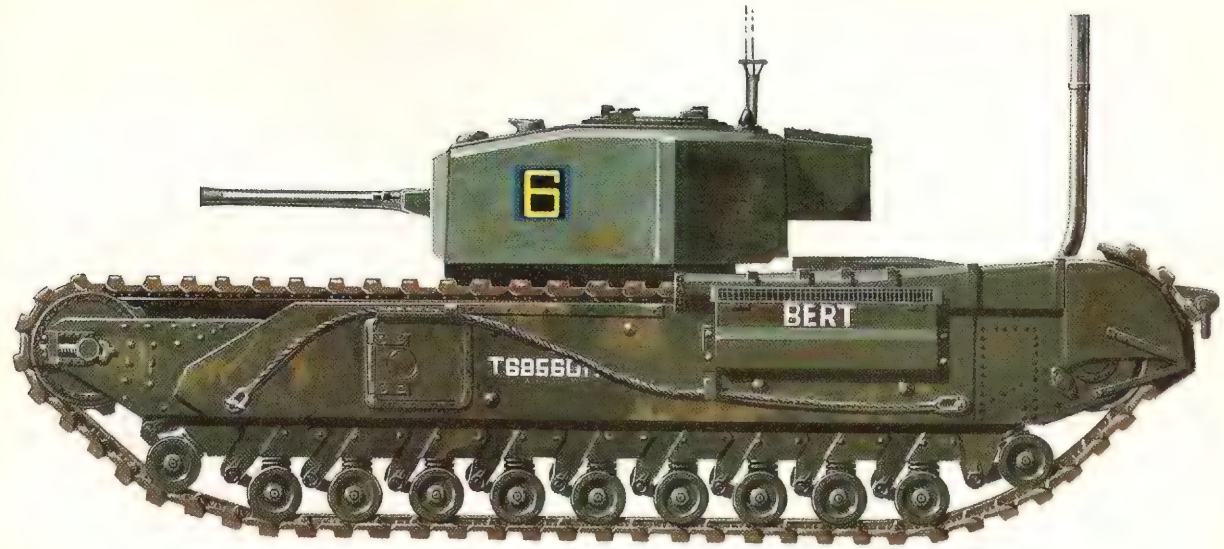
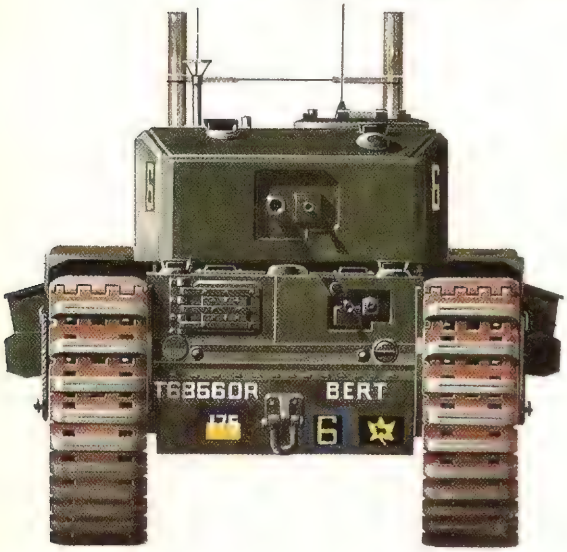






*(Above)* 'Bert', Churchill III of the Calgary Regiment, 1st Canadian Tank Brigade, equipped with exhaust extensions for deep wading, Dieppe, August 19, 1942.

*(Left)* 'Cyclops', Churchill III of 51st Royal Tank Regiment, Tunisia 1943.

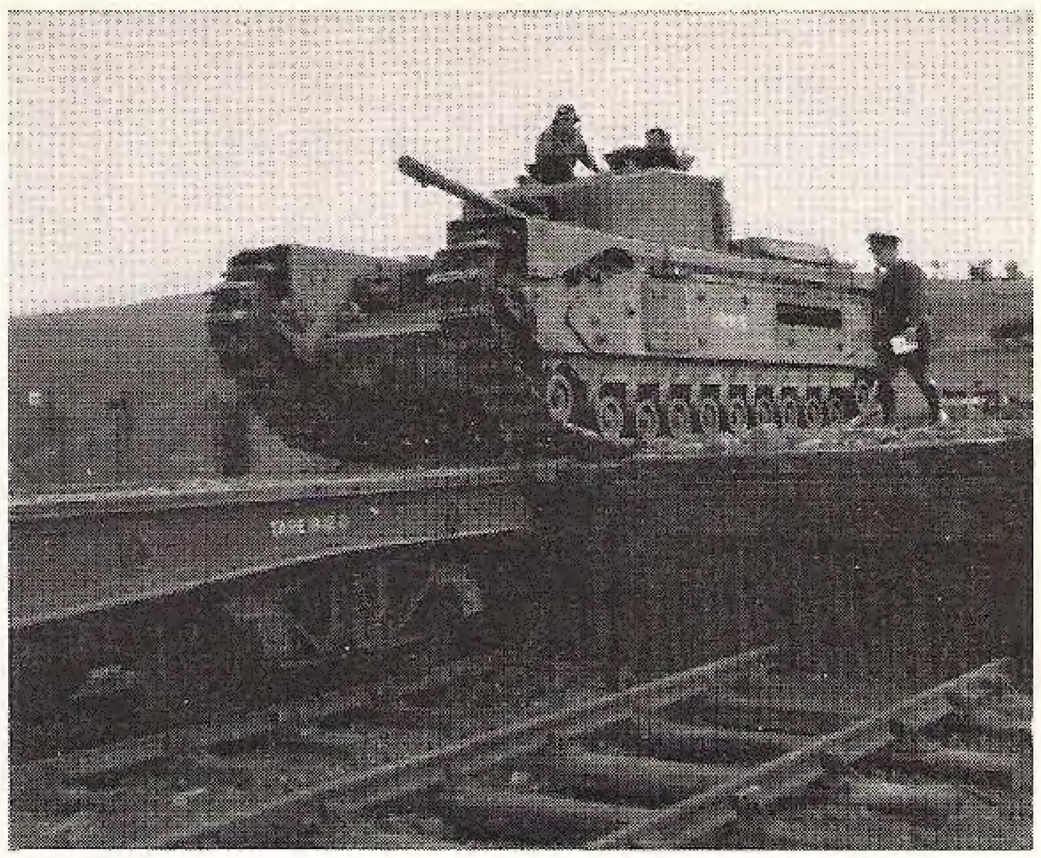
*T. Hadler* 

the campaign following D-Day, often added further protection to the turret and frontal hull in the form of spare Churchill or Sherman track links. These were welded on (or sometimes just tied) and were of particular use for protection against shaped-charge projectiles. In some cases an external plate was added by unit workshops over the coaxial gun mounting.

The specification A22F (later A42) for a new model of Churchill provided for a basic six inches of frontal armour and this type, known as the Churchill VII, was developed and produced in time to form a fair proportion of the tank strength of the three Churchill tank brigades which fought in Normandy in 1944. The Churchill VII was also the basis of the Crocodile flamethrower with which a whole tank brigade in North-West Europe was eventually equipped. A rectangular hatch in the hull floor for the installation of Crocodile apparatus was included in all Churchill VII's and VIII's.

The incorporation of this extra protection in the Churchill VII involved fairly extensive redesigning since the idea of bolting the armour on to the hull shell was now dispensed with in favour of integral armour plating which actually formed the hull. Apart from round instead of square driver's ports and escape doors (to eliminate weaknesses in these features) and a rather different turret shape, however, the new Churchill remained essentially similar in appearance. But numerous detailed improvements were included, one of the most important being a new vision cupola for the tank commander which enabled him to command

*A Churchill IV taking part in an exercise in Britain in November, 1942, marked with white crosses to indicate that it was an enemy vehicle. Censor had obliterated unit marks.*
(Peter Chamberlain Collection)

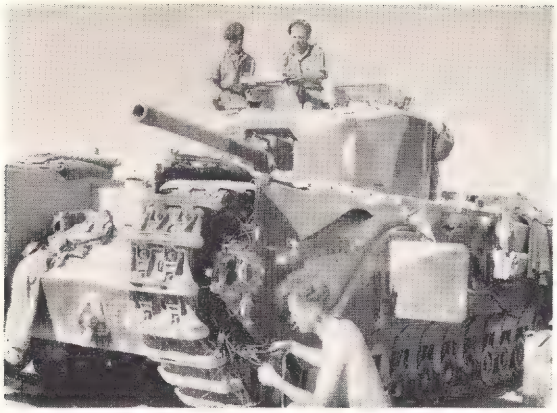


*Original restriction to within British rail loading gauge limits was one of the factors which later prohibited the fitting of the 17 pdr. gun to the Churchill, which was too narrow to take a large turret. Engine intake louvres were removable for rail transportation. Hammer and Sickle emblem on this Mk. III may indicate that it was one of the batch shipped to Russia.*
(Imp. War Mus.)

the tank more effectively when it was closed down. This device consisting of eight episcopes incorporated in the commander's revolving turret hatch was introduced after the first Churchill VII's had been built, but was subsequently fitted in the early production tanks and also, later, to some tanks of previous Marks. The Churchill VII turret was of composite construction—the vertical part cast and the roof welded. With increased protection and the other refinements the Churchill VII was a better fighting vehicle than its predecessors, although unfortunately the size of the turret ring did not allow a larger gun to be fitted and the Q.F. 75 mm. was retained. The new features increased the weight of Churchill VII by about a ton and, to offset this, heavier suspension with stronger springs was fitted, and the gearbox was modified with slightly lower ratios and the governed top speed reduced from just under 16 m.p.h. to about 12¾ m.p.h. (It may be mentioned here that one regiment, at least, had discovered by trial that the Churchill with engine governor "sabotaged" could do 25 m.p.h. downhill—a practice certainly not recommended by the manufacturers or by the War Office!)

The final basic Mark of Churchill to go into production was the Churchill VIII, which was the close support version, armed with a 95 mm. howitzer, of the Churchill VII. Further Mark numbers IX, X and XI were, however, allotted near the end of the War to Churchills III, IV, V and VI officially reworked to approximately contemporary standards of protection by the addition of appliqué armour, although all retained their original armament. Churchill IX was the Marks III and IV with new turrets (earlier, the designation Churchill III* was given to tanks which had appliqué armour added in Normandy). Mark X was the Churchill VI reworked with new turrets and Mark XI was the corresponding modified Mark V. There also existed Churchill IX LT, X LT and XI LT in which the original turrets (LT signifying "light turret") had to be retained because of a shortage of the

*See AFV No. 16.



*Close-up view of one of the three Churchill IIIs used at Alamein. Crew are re-ammunitioning. Note size of the 6 pdr. shells.* (Peter Chamberlain Collection)

heavy turrets, although the rest of the re-armouring was carried out.

Production of the Churchill ceased in October, 1945. As battle tanks they were replaced in the post-war British Army by the new Centurion series. Churchills continued in service, however, in some of the special rôles in which they had made a name for themselves in the War*. The Churchill's roomy well-armoured hull and good cross-country performance made it very suitable for adaptation for special purposes. Churchill Crocodiles were used in Korea in 1951 and the very last Churchill in service—a post-war A.V.R.E. (Armoured Vehicle Royal Engineers) modification—was retired only in 1965, 20 years after the War had ended.

## THE 3-INCH GUN CARRIER AND THE BLACK PRINCE

Two further AFV designs stemmed directly from the Churchill during the war years and, while each was of great interest, both were victims of the policy changes

*See AFV No. 16.

and fluctuations which characterized British AFV development at this period. Paradoxically, however, both vehicles, the Churchill 3-inch Gun Carrier and the Black Prince (or "Super Churchill"), represented successive attempts to overcome one of the principal shortcomings of the basic Churchill design—the physical limitations, already noted, which prevented the installation of a 17 pdr. gun.

Development of the "Carrier, Churchill, 3-inch Gun, Mark I", dated from September 1941 when the General Staff asked the Tank Board to investigate the possibility of producing both cruiser and infantry tanks with high velocity guns, as a direct result of the generally poor showing of British tanks and tank guns against the Germans in the Western Desert fighting. The cruiser tank requirement eventually led to the design of the Challenger (which is outside the scope of this narrative) with the 17 pdr. gun. Neither of the existing infantry tank designs, the Churchill and the Valentine, could mount a gun bigger than a 6 pdr., but it was suggested that the 3-inch (21 cwt.) AA gun could be fitted to the Churchill in a limited traverse mount. Stocks of 3-inch guns were then available as this weapon had by then been supplanted by the 3·7-inch gun as the army's standard heavy AA weapon.

One hundred 3-inch guns were therefore set aside for fitting to the Churchill, and Vauxhall Motors were asked to give priority to designing a suitably adapted vehicle and to be prepared to build 100 of them. Design work was in hand by December 1941, and the pilot model was ready for firing trials at Larkhill by February 1942. These proved satisfactory but the provisional order for 100 vehicles was reduced to only 24 since the War Office was by now anxious not to hold up output of Churchills with 6 pdr. guns and did not want to divert chassis into largely untried projects.

Since the manufacturers were geared up for quantity production however, with parts and armour plate

*The approach to the action at "Longstop Hill" in Tunis, January, 1943. These are Churchill IIIs of the 142nd (Suffolk) Regiment, RAC.* (Imp. War Mus.)

ordered, they not unnaturally protested at this change of plan. The order for 100 vehicles was therefore reinstated, but almost immediately cut again, this time to 50. Production started in July 1942, but the programme was further delayed by inter-departmental bickering. Because the Churchill 3-inch Gun Carrier had no turret, there was argument as to whether it should be classed as a tank or as self-propelled artillery. Eventually it was decided to class it as a tank, but this immediately brought forth a request for many detail modifications from the Department of Tank Design. By this time, however, production was under way and the alterations could not be contemplated.

In late 1942 when production was complete, progress was being made with the Challenger design, and tactical requirements and policy had changed in favour of the 75 mm. "dual purpose" gun (able to fire HE and AP shot) for future production with a proportion of 17 pdr. gun tanks. The Churchill 3-inch Gun Carrier was thus abandoned and not used operationally. However, with the gun removed some of these vehicles were adapted in 1943–44 to carry "Snake" mine exploding equipment, though in this guise they were used only for experiments and training.

The Churchill 3-inch Gun Carrier was a quick and effective improvisation for getting an AFV with a powerful high velocity gun into service very swiftly when there was a definite need for a vehicle in this class. Though eventually stifled by indecision it remains specially interesting as the only official British attempt to use an AA gun in the anti-tank rôle—in contrast to the Germans whose adaptation of the 88 mm. AA gun for the anti-tank and tank roles played such a decisive part in their AFV policy.

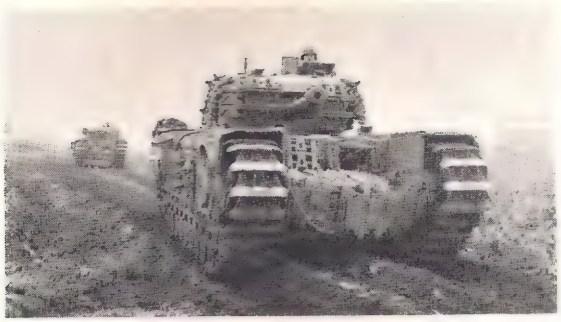
The General Staff requirement of September 1941 for cruiser and infantry tanks with high velocity guns was framed specifically with the 17 pdr. gun in mind, design of which had started in Summer 1941. In the cruiser tank category the Cromwell design had to be lengthened and widened to take a 17 pdr. turret (resulting in the Challenger design), while, as we have seen, the Churchill was adapted to take the 3-inch gun in the infantry tank category, though consideration was given concurrently to modifying the design to take a 17 pdr. gun in a turret as a long term aim.

*Four Churchills lined-up in Italy show clearly the difference between the Mk. IV (NA 75s) with 75 mm. gun from Sherman tanks, compared to a Churchill VII with 75 mm. gun, which is the second vehicle in the line. Note the commander's cupola in this later vehicle. This picture was taken in April, 1945, when NA 75s were still in service.* (Imp. War Mus.)

Like its contemporaries, however, the Churchill was too narrow for this in its existing form. This was due to several factors, including War Office insistence that all tanks be designed within British railway loading gauge limits for transportation purposes, a restriction which was lifted for later designs.

Plans to terminate Churchill production were made in late 1942 once Cromwell production got into its stride and little or no progress was made with the idea of mounting a 17 pdr. gun, though the Churchill programme was reprieved in the following year as a result of its good performance in Tunis. It was not until the end of 1943 that Vauxhall were asked to go ahead with definite plans for a Churchill with a 17 pdr. as an interim design while requirements for an entirely new "universal chassis" vehicle were formulated, this latter, incidentally, eventually emerging as the A41 Centurion. Designated A43, Black Prince, the modified design was essentially a Churchill VII with a widened hull to take a 17 pdr. gun and turret,

*A Churchill squadron (a mixture of Mks. III and IV) move forward towards the River Foglia during the Eighth Army attack on the Gothic Line, September, 1944.* (Imp. War Mus.)



*A Churchill VI, which was essentially a Mk. IV re-armed with a 75 mm. gun, seen in North-West France in October, 1944. Note the use of Sherman track shoes for added protection.* (Imp. War Mus.)

and strengthened tracks and suspension to compensate for the extra weight which was now increased to 50 tons. Armour thicknesses remained the same, as did the power plant, but the extra weight meant that maximum speed now fell to only 11 m.p.h. Work on the Black Prince started in January 1944 and six pilot models were built, ready for troop testing in May 1945. By this time, however, the first Centurion pilot models were also ready and the war in Europe was at an end. Though full trials were carried out with the Black Prince no production order was placed and the Centurion subsequently became the main British battle tank of post-war years.

## CHURCHILL IN SERVICE

From the time of their entry into service in 1941 until the end of World War II, Churchill tanks were employed in Army tank brigades—independent formations normally under direct Army command but allocated to corps or divisional commanders for training and operations as needed. In mid-1942 a new organization was introduced in which six of the Army tank brigades each replaced the third infantry brigade of an infantry division, so that the infantry would have their own integrated tank support.

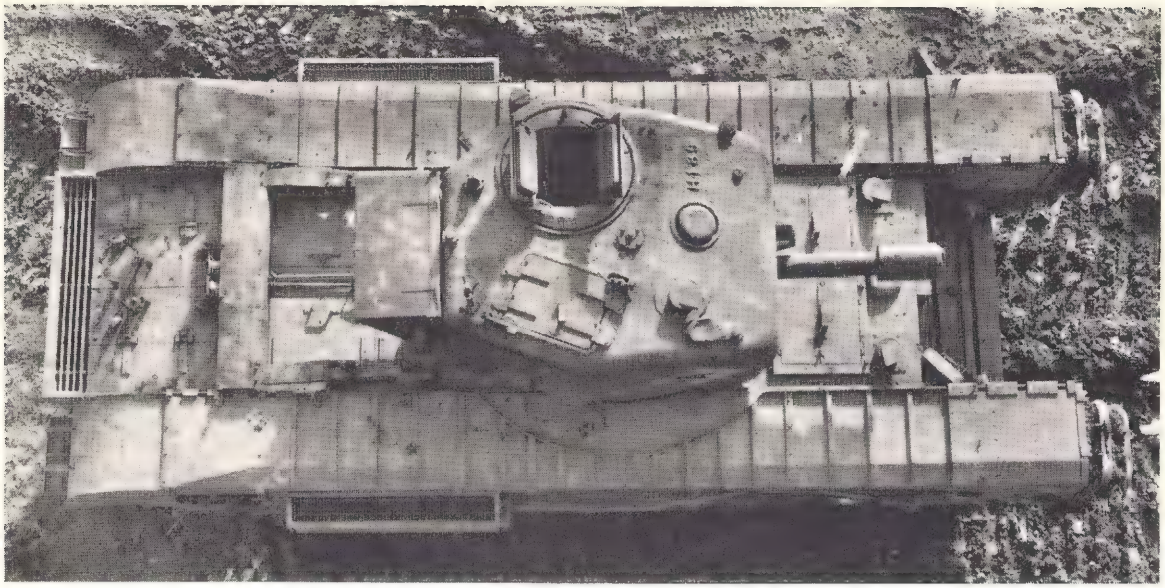
The two Army tank brigades in the Tunisian campaign—both equipped with Churchills—formed part of "mixed" divisions, although they operated in the way envisaged only on rare occasions. It was found that the mixed divisions had insufficient infantry reserves and the establishment was abolished in 1943, although the policy remained for Army tank brigades to remain in support of infantry in close co-operation.

Churchill tank battalions (or regiments) consisted of a regimental headquarters and three fighting squadrons, together with supporting vehicles. The regimental headquarters had four Churchill tanks and in addition a reconnaissance troop of 11 carriers, replaced later by Stuart light tanks, and an intercommunications troop of nine scout cars. Each squadron comprised a headquarters of three Churchill close support tanks and five troops, each of three Churchill tanks, making a grand total of Churchills for the battalion of 58. This organization was modified in Italy in 1944 when some regiments received Sherman tanks in place of Churchills in two troops in each squadron.

The employment of Churchill tank units in support of infantry naturally varied with the requirements of the action, but a typical attack in Italy (before the Gothic Line in September 1944) was described by the 142nd Regiment, R.A.C. as follows:—

"The tanks and the infantry advanced from fire position to fire position, one Churchill troop going forward, sometimes one tank at a time, supported by the fire of the others, the infantry and the tanks being within 100 yards of one another during most of the advance." The infantry company commanders and tank troop commanders kept in close touch with each other throughout, and when the attack was

*An early Churchill IV with the original 6 pdr. gun Mk. 3 distinguished by its counter weight on the muzzle.* (Imp. War Mus.)



*The Churchill V was the same as the Churchill IV, complete with cast turret, but carried a 95 mm. howitzer for support fire in place of the 6 pdr. gun.*
(Peter Chamberlain Collection)

successfully accomplished, the tanks remained to guard the flanks until the infantry had consolidated the position.

The Churchill was the final manifestation of the policy, formulated before World War II, which divided British tanks into two categories: cruiser tanks to equip the armoured divisions, mobile, relatively lightly armoured vehicles intended for employment in the "exploitation" role—the old task of the cavalry; and infantry tanks. The requirements for the latter called for heavy armour, but only modest speed. Unfortunately emphasis on the gun was lacking in both cruiser and infantry tanks, so that the fire power of British tanks lagged behind that of the Germans—their principal opponents—for nearly all of the War. The "two tank types" policy lapsed towards the end of the War, and armoured divisions and Army tank brigades alike were employed in less rigid concepts, although they remained hampered at times by their equipment and to an extent by the bias of their earlier training. The Churchill was the last type of British infantry tank to go into service—later designs reached prototype stage only—and although limited by its original specification was one of the most successful British tanks of World War II. It fought with distinction in the Mediterranean theatre from early 1943 onwards and in the North-West Europe campaign of 1944–45. (The end of the War put an end to plans for employment of Churchills in the Far East, although a few were attached to the Australians in the Pacific area for experimental purposes.) In these campaigns, the Tunisian mountains, the Gothic Line in Italy, the hard fighting before the breakout from the Normandy bridgehead, the reduction of Le Harve, and the final advance into Germany were all battles in which the Churchill proved its value.

Through the long refinement of its design the Churchill was turned into a reliable and battleworthy tank and, although never one of the easiest to maintain; a tank which had the liking and confidence of its crews. The Churchill's gun lacked range and fire power compared with enemy tanks, but the protection of its thick armour to some extent made up for this. When hit, the Churchill had the good quality—absent in many of its contemporaries on both sides—of not burning quickly. The top speed of the Churchill was not great, but the tank was lively in response to the controls and in difficult cross-country running could put up a far better performance than the majority of other tanks of its time.

The achievement of the Churchill in difficult mountain terrain in its first major campaign formed our opening theme and its performance in very different country almost exactly two years later, near the end of World War II, will make a fitting conclusion.

Two Churchill tank battalions (9th Royal Tank Regiment and 147th (Hampshire) Regiment, R.A.C.) were given the task of supporting the infantry through

*Churchill VII of the Scots Guards (6th Guards Armoured Brigade) crosses a bridge laid over a crater by a Churchill Bridgelayer during the advance on Celle, April, 1945. Note use of Sherman and Churchill track shoes for added armour protection. The track covers, incidentally, were made in three removable sections. On this vehicle, the centre section is removed, and some vehicles were seen with all sections removed giving them an appearance at first glance to the original Mk. I Churchill.*
(Imp. War Museum)

the heart of the Reichswald Forest, part of the Siegfried Line. This was in February 1945 and with torrential rain falling special Churchills carrying extra equipment (such as A.V.R.E.s and Crocodiles) got bogged down, but many of the ordinary Churchill tanks managed to get through. Even so, some became bogged down to the level of their turret tops and others had their turret traverse mechanisms wrecked through the guns hitting trees. This is without mentioning the fanatical opposition of the enemy in defending their homeland: the conditions were well suited to snipers and camouflaged S.P. guns. Nevertheless with their supporting infantry the tanks burst through to the Rhine and the heart of Germany beyond, with surprisingly few casualties, after six days spent in the permanent soggy gloom of the Reichswald. The forest had always been regarded as a complete tank obstacle. The success of the Churchills was summed up after his capture by an indignant German colonel—"Who but the British would think of using tanks in this forest? It's not fair."

**A.F.V. Series Editor: DUNCAN CROW**

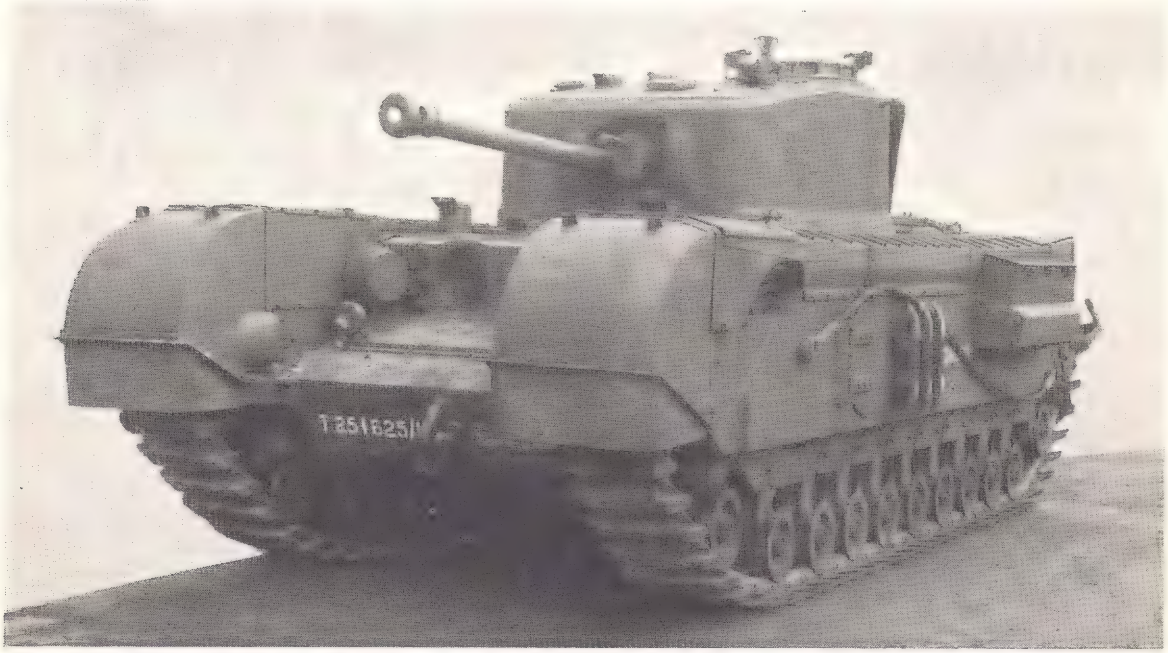
## SPECIFICATION: TANK, INFANTRY, MARK IV—CHURCHILL III

**General**

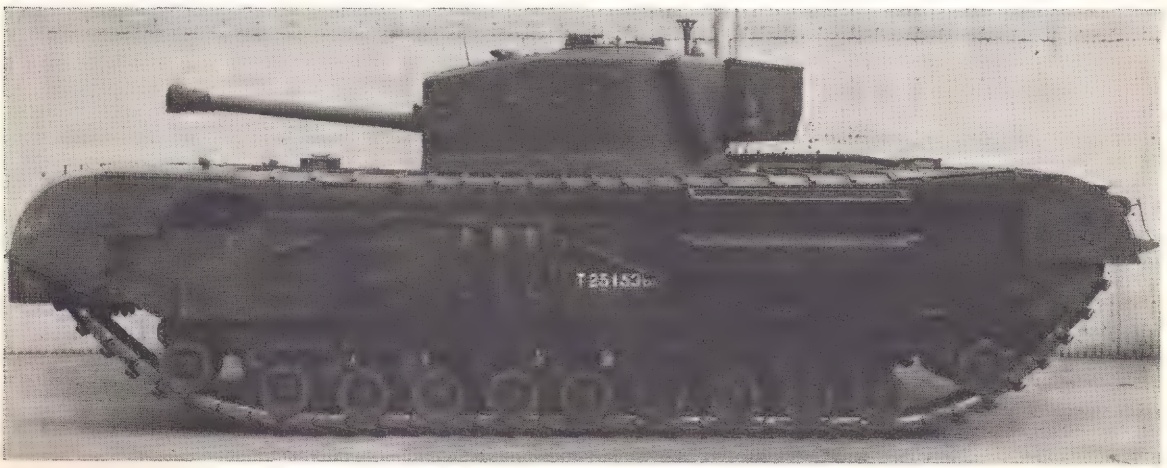
Crew: Five—commander, turret gunner, wireless operator, driver, hull gunner.
Battle weight: 39 tons.
Power/weight ratio: 8·33 b.h.p./ton.
Bridge classification: 40.

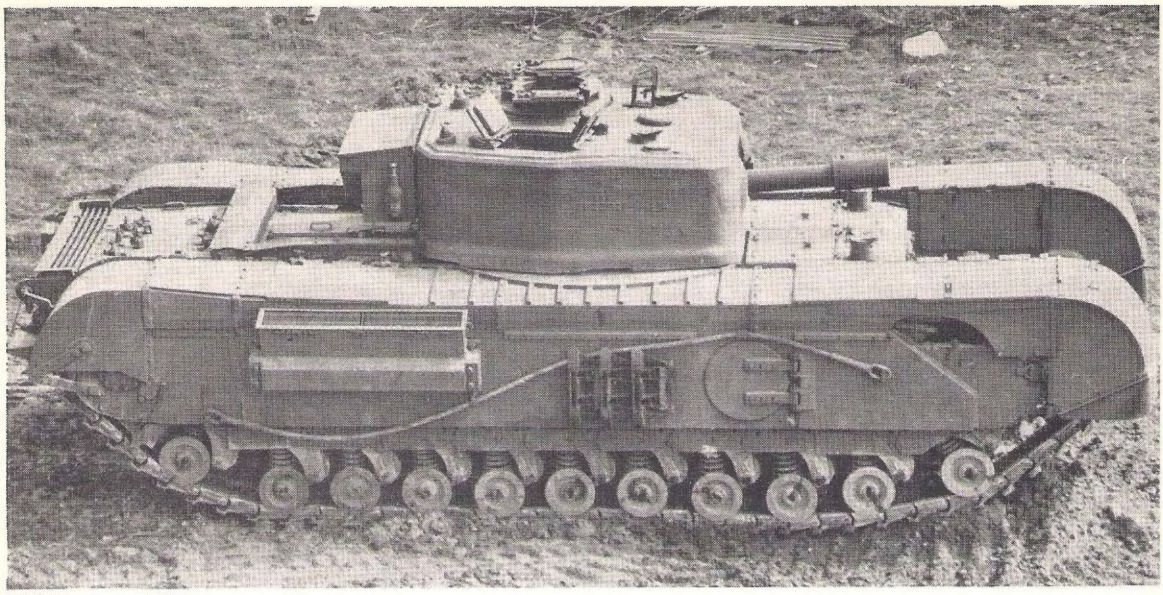
**Dimensions**

Length overall (also same as hull length): 25 ft. 2 in.
Height: 8 ft. 2 in.
Width: 10 ft. 8 in. (9 ft. 2 in. without side air louvres).
Width over tracks: 9 ft. 1 in.
Track centres: 12 ft. 6 in.
Track width: 14 in.

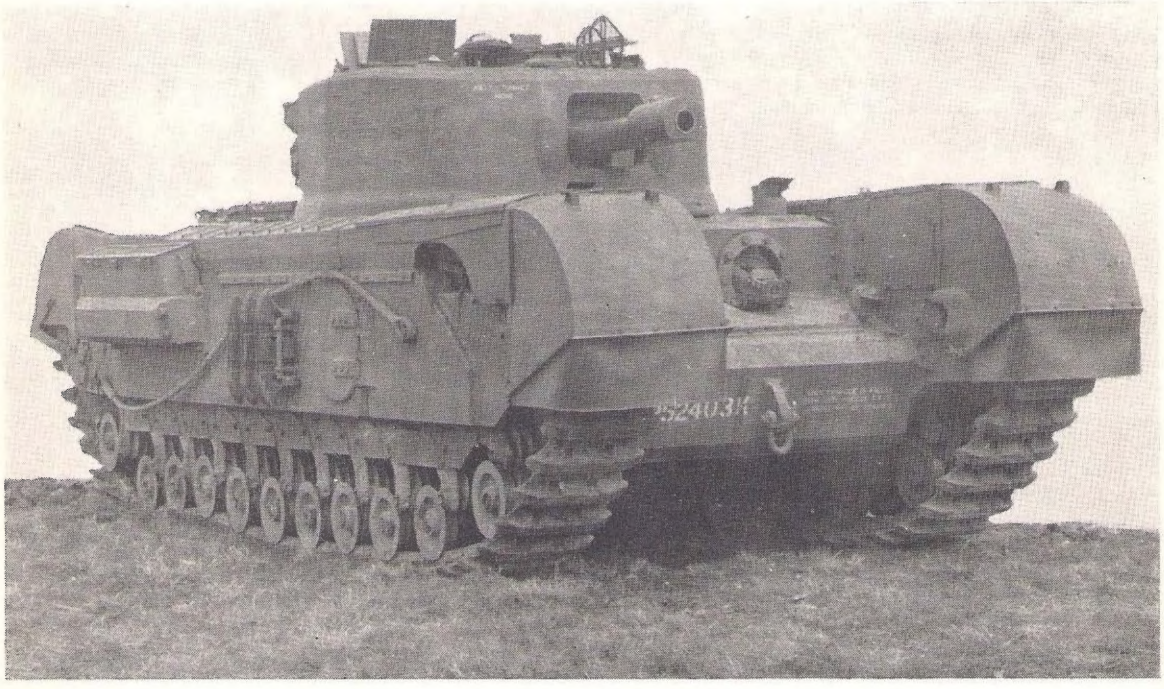


*Two views of the Churchill VII show the new turret, the commander's cupola, the 75 mm. gun, the round escape hatches and armoured covers on the exhaust manifolds, all introduced on this mark. Note also the new side appearance, the bolts having "disappeared" due to the integral armour plating on the hull.* (Imp. War Mus.)





*Two views of the Churchill VIII, the close-support variant of the Mk VII, which had a 95 mm. howitzer replacing the 75 mm. gun. Note the driver's periscope raised.* (Imp. War Mus.)



**Armament**

Main—Ordnance, Q.F. 6 pdr. 7 cwt. Mark III (calibre 57 mm.—2·244 in.) 43 calibres long. The 6 pdr. Mark V with a longer and thinner barrel 50 calibres long was also fitted in some Churchill III's.

One 7·92 mm. Besa machine-gun, mounted in turret, coaxially with the 6 pdr.

One 7·92 mm. Besa machine-gun mounted in hull front plate.

Auxiliary—one 0·303 in. Bren light machine-gun, mounted on collapsible mounting on turret roof for A.A. use, but normally carried stowed inside turret.

One 2 in. bomb thrower, mounted in turret roof. Verey pistol and Thompson machine carbine carried for crew use.

**Fire Control**

Free elevation (by means of shoulder piece) for 6 pdr. and Besa coaxial mounting—elevation maximum 20°, depression 12½°.

Traverse by electrical power: 360° rotation in 15 seconds; alternative manual operation. 6 pdr. and Besa fired (by means of pistol grips) mechanically, through cable.

**Ammunition**

6 pdr.: 84 rds., stowed in fighting compartment.

Besa: 42 boxes (each 225 rds.) stowed in fighting compartment and in front compartment.

Bren: 6 magazines (each 100 rds.) in turret.

2 in. bomb thrower: 30 bombs.

Verey pistol: 20 cartridges (green, red, illuminating).

Thompson m/c: 23 box magazines (each 20 rds.).

6 hand grenades also carried in the tank.

**Sighting and Vision**

Commander: 1 periscope on turret roof, 2 periscopes in turret hatch.

Turret gunner: 1 periscope on turret roof, 1 Telescope, Sighting, No. 39, Mk.I.S. in gun mounting.

Driver: vision door, incorporating small port protected by armoured glass block, periscope on hull roof.

Hull gunner: periscope on hull roof; Telescope, Sighting, No. 30, Mk.1 or 1A or No. 33 Mk. I.S. or II.S for Besa machine-gun.

**Communications**

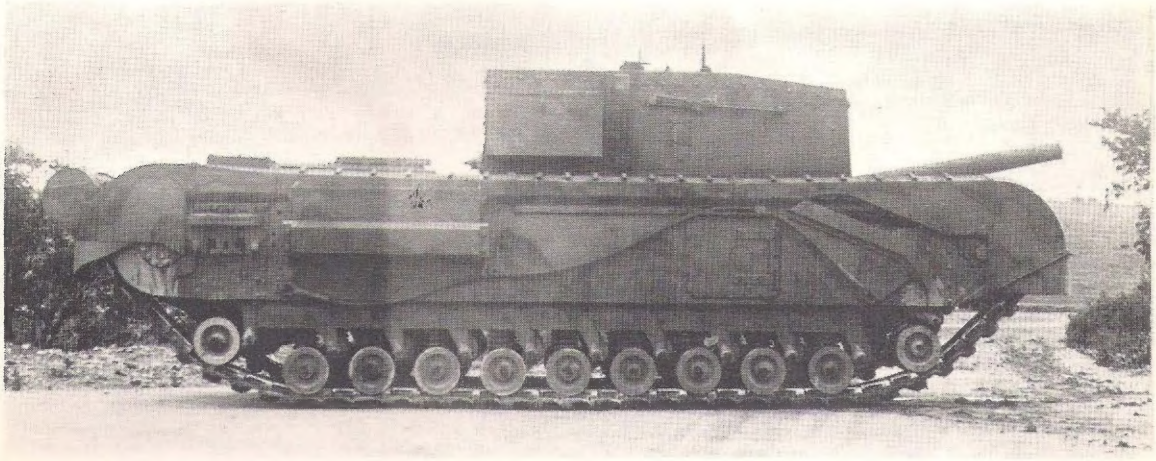
Wireless Set No. 19—incorporating 'A' set: long range, and 'B' set: short range. Also intercommunication for all crew members.

**Armour**

Turret: welded plate.

Hull: plates bolted on to frame.

*Two views of the Gun Carrier, 3-inch Churchill Mk. 1, showing the new superstructure and the limited traverse mount for the 3-inch gun. This particular vehicle is the pilot model built by Vauxhall. Production vehicles were built by Beyer Peacock.*
(Peter Chamberlain Collection)



*The A43 Black Prince (sometimes known as the "Super Churchill") was essentially similar to the Churchill VII, scaled-up to take a 17 pdr. gun. Note that the intake louvres were moved to the hull top, however, and the exhaust was led to the rear. Increased width of this vehicle to take the wider turret is noticeable. In the Black Prince, also, the commander's position was moved to the right as the gun was turned sideways for left-hand loading. Only six vehicles were built and the Black Prince never entered full production.*
(Peter Chamberlain Collection)

*Churchill, post-war—a Mk. VII, one of a small batch supplied to the Royal Jordanian Army in the mid-fifties.*
(Peter Chamberlain Collection)

*A Churchill X of the Irish Army, 1967. This is typical of the reworked models with appliqué armour, 75 mm. gun and added cupola among many other modifications. At the time this book was published, the Irish Army was the last force with the Churchill in full service. The tanks were acquired from Britain in the early 'fifties.*
(Hilary Doyle)

Thicknesses in mm.:
Hull: Front nose plate 88 mm. at 20°. Front glacis plate 38 mm. at 70°. Driver's plate 88 mm. vertical. Sides 76 mm. vertical. Rear 50 mm. vertical. Roof 16 mm. horizontal. Floor 20 mm. horizontal.
Turret: Front 88 mm. vertical. Sides 76 mm. vertical.

**Engine**
Bedford Twin-six: petrol.
12 cylinders, horizontally opposed.
Capacity 1296 cubic inches.
350 bhp. at 2200 r.p.m.
Fuel: 182½ gallons (total). 75 gals. in 3 interconnected tanks of right hand fuel system, 75 gals. in 3 tanks of left hand system (mounted inside "panniers" on either side of vehicle); 32½ gals. in auxiliary tank (jettisonable) attached to hull rear plate.

**Transmission**
Merritt-Brown 4 speed gearbox, with steering epicyclic gear trains. Ratios: 1st 6·220:1, 2nd 2·263:1, 3rd 1·176:1, 4th 0·0703:1. Reverse, 10.658:1.

**Suspension**
Eleven steel 10 inch diameter road wheels each side, independently mounted on trailing arms and sprung on vertical coil springs. The front and rear road wheels on each side mounted higher than the others.
Idler wheels—toothed sprockets, at front of vehicle. Final drive sprockets at rear.
Tracks: Heavy cast steel type, pitch 8$\frac{5}{16}$ in. 70 links per set (each side).
Light cast steel and manganese steel types—pitch 7·96 in. 72 links per set.

**Electrical System**
Main dynamo 12 volt, mounted on top of engine. Turret traverse dynamo mounted on floor of gearbox compartment.
Auxiliary generator (Delco-Remy unit—dynamo driven by single cylinder 4 stroke aircooled petrol engine) carried behind hull gunner's seat.
Batteries: Two 6 volt, connected in series.

**Performance**
Maximum speed recommended: 15½ m.p.h.
Vertical obstacle: 2 ft. 6 in.
Trench: 10 ft. 0 in.
Wading depth (unprepared): 3 ft. 4 in.
Range: 120 miles approx. (with auxiliary fuel tank).

# AFV

The new **Profile Publications** AFV Series of books on the Armoured Fighting Vehicles of the World, will continue the pattern established by the twenty-four issues of Armour in Profile. But there will be a big difference—in presentation, format, size and cost.

The new Series will be published in thirty monthly parts and each will contain twenty-four pages of text, up to fifty photographs, plus a full colour centre-spread of the subject tank depicted in five views, plus additional views of modified chassis.

AFV will be Edited by Duncan Crow and contributors will include many well-known names such as Peter Chamberlain and Chris Ellis.

The thirty-month programme is as follows, and each part can be obtained from your local Profile stockist, or any bookshop, model shop or newsagent, or direct from the publishers.

| *Part* | *Title* |
|---|---|
| 1 | Churchill—British Infantry Tank Mark IV |
| 2 | PanzerKampfwagen III |
| 3 | Tanks Marks I–V |
| 4 | Stuart/Honey |
| 5 | Light Tanks Marks I–VI |
| 6 | Valentine—British Infantry Tank Mark III |
| 7 | Mediums Marks A–D |
| 8 | Crusader—Cruiser Tank Mark VI |
| 9 | Early British Armoured Cars |
| 10 | PanzerKampfwagen V Panther |
| 11 | M3 Grant |
| 12 | Mediums Marks I–III |
| 13 | Ram |
| 14 | Bren Universal Carrier |
| 15 | PanzerKampfwagen I and II |

| *Part* | *Title* |
|---|---|
| 16 | Churchill and Sherman Specials |
| 17 | Russian KV |
| 18 | PanzerKampfwagen 38(t) |
| 19 | Armoured Cars—Guy, Daimler, Humber |
| 20 | Sherman '75' |
| 21 | French Mediums |
| 22 | T–54/T–62 |
| 23 | LVT I–IV |
| 24 | German Armoured Cars—Sd Kfz 231–4 |
| 25 | M48/M60 |
| 26 | Russian BT |
| 27 | Type 97 Medium |
| 28 | Saladin Armoured Car |
| 29 | Conqueror, M103, JS III |
| 30 | AMX30, Leopard, Chieftain |

A new and valuable feature of AFV will be the hard back bound volumes, which will appear concurrently with the monthly parts. These volumes, seven in all, will eventually cover in depth the history of the Armoured Fighting Vehicles of the World from the first lumbering giants of World War One, to the Panzers of World War Two and the computerized killers of today.

Each of the seven volumes will include a number of AFV parts, supplemented with additional new material on contemporary AFVs. Thousands of words of text, hundreds of new photographs and pages of new, full colour, general arrangement drawings of AFVs, together with the tank men's uniforms, which will show (in colour) the various battle colours and insignia.

Watch out for the new Profile AFVs and the luxury bound volumes, all at your local retailer during the next thirty months.

| | |
|---|---|
| **Volume One** | **AFVs of World War One** |
| **Volume Two** | **British AFVs 1919-1940** |
| **Volume Three** | **British AFVs 1940-1946** |
| **Volume Four** | **American AFVs of World War Two** |
| **Volume Five** | **German AFVs of World War Two** |
| **Volume Six** | **AFVs of World War Two: Russian, French, Japanese, Italian** |
| **Volume Seven** | **Modern AFVs** |